

THE PRESSURE REGIME 10 - 750 MBAR:
USE OF LASERS IN EOS MEASUREMENTS*

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For more than a decade the use of intense lasers has been proposed in order to generate Mbar pressures in matter for the study of high energy density equations-of-state. It has been recognized that lasers may not be the ideal tool for these extreme EOS investigations, but they do provide the only method of accessing this regime in the laboratory. Improvements in technique and technology, such as the use of smoothed laser beams and indirect drive, have led to the reliable production of uniform > 10 Mbar shocks in solids. High pressure shocks produced by direct laser irradiation of solids can be made in nonconvergent geometry with spot diameters of about 0.5 mm but require a laser absorber thick enough to smooth out intensity variations inherent even in smoothed beams. We have used the Nova laser to perform laser-driven analogs of standard flyer plate experiments, where a thin foil is accelerated to high velocity before striking a stationary foil. In order to diagnose this kind of experiment, we have developed a radiography technique which makes use of a soft x-ray laser. We have found that directly-driven accelerated foils show early evidence of instability and foil breakup in flight due to laser imprinting. In contrast, utilizing a high-Z hohlraum to convert the laser energy into an x-ray drive results in uniform accelerations. We have demonstrated inferred shock pressures of 750 Mbar in gold with this technique. As will be discussed, this technique is still being developed. The smooth x-ray drive available from a hohlraum can also be used to obtain Hugoniot data up to 100 Mbar in materials transmissive to hard x rays by using varying x-ray contrasts in impedance-matched targets and by employing standard impedance mismatch techniques.

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